The National Dialogue (COOL). Results and recommendations

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The National Dialogue (COOL)
Results and recommendations

Synthesis Report

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Climate OptiOns for the Long term

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Box 1 The National Dialogue as a process

The project National Dialogue was carried out by a project team and a scientific support team. The project team's main responsibility was to organise and facilitate the dialogue and to report its results. The scientific support team provided the dialogue groups with 'state of the art' scientific information on options to reduce greenhouse gasses in the Netherlands. The members of the scientific support team were as well involved in the project team.

The project has been carried out in three phases: a design phase, the actual dialogue phase and a reporting phase.

During the DESIGN PHASE the project team interviewed about 100 persons from the four sectors involved on the dialogue's scope and focus and the possible composition of the dialogue groups. These interviews have contributed a great deal to the design of the actual dialogue. For each dialogue group, chairpersons were contacted. About sixty persons accepted the invitation to participate in the dialogue on an individual basis. In the meantime, the scientific support team developed Future Images (see Box 2). The dialogue participants received two notes for approval, the first addressing the dialogue's Scope and Rules of the Game, the second dealing with the dialogue's Process and Schedule.

The actual DIALOGUE PHASE was divided into three steps:

1) First, the dialogue groups discussed the Future Images presented by the scientific support team. Inspired by these images, they developed two images for their sector, which both took –80% GHG emissions as a starting point. These images constituted the point of departure for the analysis of options in the second stage of the dialogue.
2) The groups then selected options for emission reduction for further analysis. They analysed the options using the backcasting technique. This meant that the dialogue group took the final situation where the option has been implemented as a starting point. For a period of fifty years from now, the chances and barriers for the option were identified and the major problems solved. Finally, the results of the backcasting exercise were visually presented on a time sheet.
3) Finally, the groups compared the outcomes of the separate backcastings in order to identify criteria for long-term climate policy. Then, they identified clusters of options that, to their point of view, meet their criteria, and identified actors and policy instruments, which they considered vital for implementation.

Each dialogue group has met six times between November 1999 and March 2001. Representatives of each group also met at two joint workshops, where they exchanged interim results and discussed their conclusions.

In the REPORTING PHASE, the findings for each sector were laid down in so-called strategic vision reports, sectoral policy briefs, and this synthesis report, which were reviewed by the participants.

For more information about the COOL project, see: http://www.nop.nl/cool.

1. The National Dialogue in the COOL project

The National Dialogue in the COOL project (Climate OptiOns for the Long term) aimed at developing insights and recommendations for Dutch long term climate policy, both on content and process. The dialogue was carried out in four dialogue groups, which addressed four sectors of the Dutch economy: Housing, Industry & Energy, Agriculture and Transport. For each of these sectors, the dialogue addressed the following question: What is needed to realise reductions up to 80% by 2050 (as compared to 1990 levels) for greenhouse gas (GHG) emissions in The Netherlands? Dialogue participants did *not* address the issue as to whether such an emission reduction would be desirable as a climate policy target. Whereas the realisation of –80% for The Netherlands by 2050 was taken as a point of departure, the dialogue explored implementation trajectories for reduction options using a method, which is known as backcasting. It is also important to note that the dialogue groups were asked *not* to fake consensus in their strategic recommendations. Hence, the dialogue outcomes articulate differences in view with respect to the preferred trajectories for delinking GHG emissions and economic growth.

This report presents and synthesises the findings and conclusions from the National Dialogue taking into account the divergent views among and within the dialogue groups. The authors are the only responsible for this report's contents, especially its recommendations.[1]

The conclusions and recommendations laid down in this report are meant for all who are, in one way or another, involved in the development and implementation of climate policies, especially the Dutch government and Parliament, business, and the environmental and consumers movements.

Findings and conclusions from the National Dialogue mostly address climate policies for the period 2012 – 2050, that is the period after Kyoto. Section 2 focuses on the analysis of options for major emission reductions carried out by the four dialogue groups. Section 3 presents the trajectories toward –80% GHG emissions by 2050 for the sectors Housing, Industry & Energy, Agriculture and Transport. Together, these trajectories indeed count for about an 80% reduction potential for the Netherlands in 2050. Section 4 then highlights the criteria that, according to the dialogue, should underlie long-term climate policy. This section also elaborates the doubts and conflicting views from the dialogue on long-term climate policy. Finally, section 5 presents recommendations. These are meant for the coming 5 – 10 year period, when the Netherlands should prepare for the long term and take especially into account the uncertainties and conflicting views that have been put forward in the dialogue.

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1 A former version of this report has been reviewed by participants and the members of the COOL external review committee. It was also discussed at the national COOL conference held in Amersfoort on May 11, 2001. The reactions were mainly positive. Some participants were critical about the recommendation on CO_2 removal and storage.

Box 2 Two future images for The Netherlands in 2050

To encourage the dialogue, the scientific support team developed two future images of The Netherlands in 2050, which both sketch a society that has been able to realise –80% GHG emissions. The images are based on two scenarios used by IPCC, which have been quantified with respect to the Dutch situation.

According to the images A and B, for the 1990 - 2050 period, production grows 4 – 6 times. The images differ more with respect to the increase in per capita income, as the population size in A is assumed to be smaller than in B. Without major technological innovations, the Dutch economy would double its energy consumption, compared to 1990 levels. However, it is assumed that because of major achievements in material and energy efficiency the final energy demand is about 30% **under** the 1990 level. A set of plausible choices as regards fuel supply and CO_2-removal and storage bring down the total Dutch CO_2-emissions to 40 Mton/year (= -80% /1990).

		Image A	**Image B**
World-orientation		Cosmopolitan, Global Village	Regions, trade blocks
Economy		High growth and dynamic, market	Moderate growth, strong regulatory government
Social		Individual	Community, family
Physical Environment		Sub urbanisation, fragmentation	Careful planning
Transport		Road transport Private transport	By train and ship Public transport
Environmental attitude		Economic values	Environmental values
Population	(million)	16	19
GDP	(1990 = 100)	570	440
Private car, km	(1990 = 100)	170	170
Agriculture, km	(1990 = 100)	65	78
Energy demand	(PJ)	2000	1800
Fossil	(PJ)	950	400
Biomass	(PJ)	800	1200
Solar / wind		135	170
Nuclear	(PJ)	80	0
CO_2-storage	(Mton)	50	5

The dialogue groups have elaborated these images for their respective sectors. The groups have done this in quite different ways. For Industry and Energy, two technological trajectories were defined toward –80% (Clean Fossil and Sustainable). For Transport, a distinction was made between a sector, which has all freedom to expand, and a sector, which is bound by governmental restrictions (Free Way and Moderate Transport). For the Housing sector, it is assumed that the dominant factor with respect to emission reduction is the replacement tempo of buildings (The renewed Netherlands vs. The familiar Netherlands). For agriculture, the distinction was found in different scenarios for the sector under environmental restrictions (Low emission Bulk vs. Mixed Landscape). That the groups have used two contradictory images in exploring the viability of reduction options explains the range in the emission reduction figures for the sectors, because these figures have been calculated for two images per sector.

2. Analysis of options for emission reduction

In order to learn about opportunities for considerable emission reductions on the long term, the dialogue has investigated chances and barriers for the implementation of 22 (mostly technical) reduction options. For each analysis, the groups have taken either one of two conflicting images for the sector as a point of reference. Both images unfold a future in which The Netherlands have been able to reduce its GHG emissions by 80%, but in most other aspects the images contradict (see Box 2). Some options have been evaluated by several groups, i.e. biomass, solar PV and wind. Box 3 gives an overview of the 22 options that were analysed by the four dialogue groups.

Box 3 indicates that the dialogue groups have restricted their scope. Obviously, it was impossible to analyse all kinds of options given the limited time available for the dialogue. In some cases, assumptions were formulated as regards the options that were not taken into consideration. The absence of the nuclear option may need some clarification. Several dialogue groups have discussed as to whether nuclear should be given attention in the backcasting. Arguments for not doing this in the Dutch context are inter alia the most controversial character of this option in The Netherlands, the persistence of the nuclear waste issue and the limited uranium stocks for the long term.

All options that were analysed may, potentially, largely contribute to significant reductions of greenhouse gasses in The Netherlands. However, the implementation of each option will face considerable barriers, even if the trajectory for implementation is assumed to be 50 years. In some cases, there is considerable doubt as to whether implementation will be possible at all, such as to draw back the demand for transport through a change of individual behaviour. At the same time, opportunities were identified for national government, the EU and private parties. Box 4 presents an overview of the major barriers and opportunities as identified in the backcasting exercises.

In general, the main barriers relate to problems at the level of government (especially for options that ask for a joint European approach) and a lack of public acceptance. The general trend of government retreat in an era of liberalising energy markets appears in conflict with the needs for implementing a variety of climate options. After all, this requires a major role for public institutions in many areas.

Major opportunities are identified at with respect to technology development and, as an opportunity too, public acceptance. Climate policies in The Netherlands can in a positive way contribute to domestic comfort, a reduction of traffic annoyance, a more pleasant landscape, and will not negatively affect matters that people care about, such as income and mobility.

Box 3 Options analysed in the four dialogue groups

• Biomass (Industry, Agriculture, Transport) • Chain optimisation of wood (consumption) (Agriculture) • Combined heat and power (Industry) • CO_2 neutral greenhouse (Agriculture) • CO_2 removal and storage (Industry) • Draw back demand for transportation through behaviour change (Transport) • Energy-efficiency in industry (Industry) • Fuel cell (Transport); also see under Hydrogen) • Heat Pump (Housing) • Hydrogen economy (Industry, Transport) • Measures to reduce emissions by land management (Agriculture)	• Measures to reduce emissions from manure and fermentation (Agriculture) • Micro-combined heat and power (Housing) • Modal shift from private to public transport (Transport) • Modal shift from air to train (Transport) • Modal shift from road to water (Transport) • Passive solar (Housing) • Replacement tempo of buildings (Housing) • Sinks (Agriculture) • Solar PV (Housing, Industry) • Underground transport (Transport) • Wind (Housing, Industry)

Box 4 Main barriers and opportunities

Barriers	Opportunities
• Technology development • Vested interests in sector • Costs (compared to other options) • Public acceptance (a variety of image and acceptance issues) • National government (internal coordination and enforcement) • European Union (especially coordination) • Infrastructure • Scarce space	• Technology development • Public acceptance / Image • Fit in with trends in sector • Efficient use of scarce space • National government

3. Long term trajectories toward -80%

For each sector, specific trajectories (packages of options) were identified to realise a reduction of emissions up to 80% by 2050. These trajectories are mostly complementary, but in some instances they are in conflict with one another.

Housing

For the sector Housing two complementary are proposed, one for existing buildings and one for the construction of new buildings.

The package **Existing Buildings** looks as follows (in this preferential order):

- Dwelling insulation (roof, crawling space and housing front),
- Sustainable energy applications (solar boiler, solar PV, wind)
- Low-calorific heating: heat pump combined with micro combined heat and power (CHP), as successor of the high efficiency boiler.

The package **New Buildings** consists of (in this preferential order):

- Integrated design with optimal orientation to the sun and use of day light,
- Optimal thermal insulation,
- Balanced ventilation with recovery of heat,
- Sustainable energy applications (solar boiler, solar PV, wind)
- Low-calorific heating: heat pump combined with micro CHP, as successor of the high efficiency boiler.

It is assumed that the reduction potential for houses applies at least to the same degree to utility buildings.

The dialogue group has a strong preference for sustainable energy options that can be applied at the level of buildings. It also sees a potential for wind energy. It is expected that consumers will prefer renewables and are even willing to pay more for this, if needed. Only if renewables will prove insufficient to realise -80% by 2050, CO_2-removal and storage should be applied. Hence, also the fossil part of the energy supply will become CO_2 neutral.

Dependent on assumptions related to the replacement tempo of houses and utility buildings, an emission reduction up to 80 – 90% comes into sight. As the replacement tempo accelerates, it will be possible to realise somewhat more reductions (emissions related to removal and reconstruction of buildings included).

The question remains as to whether electricity from the grid can be produced sustainably or clean fossil must be applied as well.

Box 5 Emission reductions for two trajectories in the sector Housing

A calculation for houses shows the following results for 2050:

- Under ***autonomous developments*** (i.e. without addition options), CO_2 reduction through improving efficiency in buildings and power stations will exceed the increase of CO_2-emissions as consequence of the increase of the total building stock. CO_2-emissisions go down by 10 – 25% in 2050 as compared to 1990 levels.
- If ***additional reduction options*** *inside* the dwelling are used to its maximum potential, CO2 emissions will further go down to -60 – -70% as compared to 1990 levels.
- If also ***'clean' electricity*** can be supplied by the grid, a further reduction will be possible up to 80 – 90% as compared to 1990 levels.

Hence, a realisation of –80% appears within reach.

Box 6 Emission reductions of CO_2 for three conflicting trajectories in the sector Industry & Energy

	Clean Fossil		Sustainable Energy system		Hybrid	
Scenario & supply mix	Emission Megaton CO_2	Reduction	Emission Megaton CO_2	Reduction	Emission Megaton CO_2	Reduction
Low growth	16	75%	15	76%	18	72%
High growth	26	60%	26	60%	29	55%
High growth, no materials eff.	30	54%	31	52%	34	48%

For an understanding of these figures: The 1990 CO_2-emissions for Dutch industry were about 64 Megaton

Industry & energy

The first observation with respect to the industrial sector is that a major improvement in efficiency is indispensable for the realisation of –80% by 2050. Especially for the short and medium term, much is expected from combined heat and power. The second observation is that all supply options that really matter, biomass, CO_2 removal and storage, and renewables (wind, solar) are, for different reasons, controversial. However, if an 80% reduction is to be realised by 2050, it is most likely that all available options should be applied, thus efficiency, renewables as well as CO_2-removal and storage.

For the sector, three to a large extent conflicting trajectories have been figured.

- In the trajectory **Clean Fossil,** 80% of the energy carriers come from fossil sources, natural gas in particular. Here, the focus is on developing a Hydrogen infrastructure, CO_2-storage, biomass and CHP (combined heat and power). Assumed is a moderate efficiency improvement (35% or 0,75% per annum).
- In the trajectory **Sustainable Energy system,** about 70% of the energy carriers come from renewable sources, imported biomass in particular. There is also a focus on solar and wind. Assumed is a high level of efficiency improvement (50% or 1% per an-

num). In this trajectory, there is no effort to develop the clean fossil package CO_2-storage, hydrogen and CHP.

- The third trajectory is a **Hybrid**, which combines the other two except biomass. It includes solar and wind but also CO_2-removal and storage, Hydrogen and CHP. For this trajectory, a low rate of efficiency improvement is assumed (20% or 0,4% per annum).

The reduction of CO_2 emissions for the three trajectories is presented in Box 6. Dependent on assumptions on sector growth, efficiency improvement and the contribution from CO_2 neutral supply options, the sector industry and energy may realise an overall reduction up to about 50 – 75% by 2050 as compared to 1990 levels. Additional reductions could be realised by the using CO_2-neutral feed stocks (biomass in particular) in among others the fertilisers and chemical industry. If all these options would be utilised, it will be possible to realise a (theoretical) reduction of almost 100% for the industry & energy sector.

Box 7 Contribution to emission reductions by the sector Agriculture

	Reduction potential*) (Megaton CO_2-eq.)
Reduction primary production	
• CO_2 neutral greenhouse	9-14
• Closed stables	2-3
• Emissions per cow	0.5-1.5
• Organic fertilizers	Uncertain
• High efficient use of fertilizers	1
Total primary production	*12-18*
Sustainable energy and materials NL	
• Utilisation of agri residuals	0.5-1
• Manure fermentation	0.5-1
• Combustion of (dry) manure	1
• Bio-energy production NL	1
• Wind farms on shore	1-1.5
Total sustainable energy and materials NL	*4-6*
Sustainable energy sources and materials from abroad	
• Chain optimisation of wood consumption	2
• Bio-energy production imported (400-500 PJ)	38
Total sustainable energy sources from abroad	*40*
Sinks	
• Increase groundwater level in peat pastures (450 kha)	?5-7**
• New forest (350 kha)	?1
• Forest and land management	?1
Total sinks	*?7-9*

*) The reduction potential of the options cannot simply be added because of overlap.
**) ? means that the net effect is uncertain

Box 8 Energy use figures for transport, translated into CO_2 figures

CO_2 emissions in Megaton		
1990 level		28
Trend 2050		60-75
Total Effect trajectories 1-3 compared to trend		-25
	Technical solutions	-15
	Draw back demand	-5
	Modal shifts	-5
Results for 2050 without CO_2 neutral fuels		35-45 (+20-50%)

Agriculture

For the sector agriculture it is assumed that policies are developed and implemented in a European context. Three complementary trajectories are suggested,

- **Measures as regards the primary production:** CO_2 neutral greenhouses, closed stables where animals have sufficient space, organic instead of artificial fertiliser and a huge improvement in the efficiency of fertilizer use.
- **Energy production and chain optimisation of wood consumption.** Energy production relates to the available biomass and on shore windmills. Optimisation of wood consumption supposes that wood is primarily used for high-level applications, especially for construction, and only in last instance as fuel.
- It is supposed that **interventions in the food chain** will, too, significantly reduce emissions, but these have not been analysed in the backcasting.

Next to these trajectories, there are opportunities for sinks as a means to contribute to CO_2 reductions. Possibilities in this respect are to change cropland into pastures, new forests, less deep ploughing, and especially by increasing the groundwater level in the peat pastures (this prevents peat oxidation and stimulates the formation of new peat). Thereby should however be counted with great uncertainties in the net results.

Box 7 summarises possibilities for Dutch agriculture to reduce CO_2 and non-CO_2 greenhouse gasses considerably, inside and outside the sector itself. The range in figures is caused by different expectations as regards the volume of primary production by 2050.

- Implementing measures related to primary production renders an emission reduction of 12-18Mt CO_2 eq. This yields 60-80% reduction in the remained emissions (5-10 Mt CO_2/eq) compared to 1990 level.
- Energy production and optimisation of wood consumption renders an additional reduction in the order of 6-8,5 Megaton CO_2-eq. (this is 25-35% of the overall emissions from the sector in 1990).
- Sinks could render another 7-9 Megaton CO_2 (also 25-35% of the sector's emissions in 1990).

This means that, in total, the sector can be able to reduce 100-150% of its own emissions by 2050. Interventions in the food chain are not yet included in this figure.

Most remarkable is the sector's contribution to reductions in other sectors. The shift from artificial to organic fertiliser, in combination with efficiency in use, will, if this measure is applied outside The Netherlands as well, probably render a reduction in the order of 8-11 Megaton CO_2 equivalents (N_2O en CO_2.) This branch of industry will be likely to shift its core business in The Netherlands. Cement production will be affected by a chain optimisation of wood consumption, as the use of concrete in construction will be reduced. In total, agriculture may reduce 14-19 Megaton CO_2-eq. in other sectors.

Transport

For this sector, a general observation is that economic developments leading to an increased demand for transport cannot in such a way be influenced by the sector that this will bring the demand down.

Four trajectories to –80% by 2050 were formulated:

- The trajectory **CO_2 neutral transport fuels** includes the development and use of bio fuels and / or clean fossil transport fuels combined with CO_2-removal and storage.
- The trajectory **Technological solutions to draw back energy demand for vehicles** includes the development and use of efficient vehicles. Hence, it will cost less energy to meet total demand for transport.
- The trajectory **Draw back of demand for transport** includes behaviour change on the side of individual citizens and more efficient commodity transport thanks to ICT, which leads to driving less 'empty' kilometres.
- The fourth trajectory is **Modal shifts**. This includes shifts from road to water, from air to rail and from private to public.

Major breakthroughs for addressing the climate issue are especially expected from the first and the second trajectory. However, modal shifts toward low energy / CO_2-efficient modes of transportation and drawing back the overall demand for transportation are claimed to be necessary, too. This claim is warranted by two observations: First, the considerable growth of the sector, which is expected for the decades to come, is likely to put a large strain on the availability of CO_2 neutral transport fuels. It is thus assumed that there maybe limits with respect to the availability of CO_2 neutral fuels (e.g. from biomass and renewables). Secondly, modal shifts appear relevant in the context of other issues than climate change, especially those that relate to scarcity of land space and congestion.

Calculations have been made with respect to the possible energy use developments in the trajectories, except the one, which focuses on clean transport fuels. The results were translated into figures for CO_2, as presented in Box 8. It turns out that energy use by the sector, in spite of a package of powerful measures, will increase by 20 - 50% in 2050. This figure clearly shows that the use of CO_2 neutral fuels in combination with other technological solutions, such as the fuel cell, will be indispensable for realising far-reaching emission reductions. Without this option, the realisation of any reductions will become highly uncertain, as the growth of the sector exceeds the impact of efficiency improvements. Therefore, the market penetration of CO_2 neutral fuels will in the end to a large degree determine as to whether greenhouse gas reductions become realised in the sector. Theoretically, reductions up to 100% become then a possibility.

Box 9 Findings for the four sectors in 2050

Sector	Housing	Industry & Energy	Agriculture	Transport
Trajectories	Existing buildings: sustainable New buildings: sustainable	Clean Fossil: CO_2 storage, H_2, efficiency Sustainable Energy System: Biomass, wind, solar, high efficiency Hybrid: CO_2, H_2, sustainable	Primary sector Energy and materials Sinks	Draw back of demand for transportation Efficiency – Modal shifts Clean fuels
Emission reduction	80–90%	50-100%	100-150%	??-100%

The outcomes of the dialogue in the sectors Housing, Industry & Energy, Agriculture and Transport suggest that reductions up to 80% by 2050 for The Netherlands are possible. It may however happen that trajectories identified for different sectors are in conflict with one another. It may be questionable as to whether Clean Fossil (Industry & Energy) will be capable of providing sufficient electricity from renewables to houses and buildings (Housing). It is also doubtful as to whether there will be sufficient biomass to meet the various claims. After all, both the Transport and Industry & Energy sectors put a claim on imported biomass, to meet the energy demand of households and businesses and to meet the need for clean transport fuels. An important point to be mentioned also is that trajectories may have different implications costly infrastructures. A trajectory sustainable energy system supposes high investments that are very different from the investments required by a clean fossil scenario. The dialogue has noticed that such inconsistencies do exist but has not addressed them further.

4. Choices for the long term

Box 9 summarises the findings related to the four sectors. From these findings a considerable number of dialogue participants concludes that, under certain conditions that The Netherlands cannot all establish or guarantee, such drastic emission figures as –80% by 2050 becomes imaginable. However, in the dialogue several doubts have been raised as to whether –80% may be practically feasible. It will not be possible to implement all options at the same time. Even within a schedule of about fifty years from now, choices may not be avoided.

This becomes clear if the criteria, which the four dialogue groups have identified as relevant for long-term climate policy, are taken into consideration. They are explained in Box 10. The dialogue unanimously concludes that climate policy in The Netherlands should foster options that meet the criteria *climate effectiveness*, *sustainability*, *cost effectiveness* and *social support*. Yet, these criteria are not always compatible and may even be in conflict. At this point, opinions diverge.

First of all, there are different views and expectations with respect to what is feasible and socially acceptable, given the current state of technology. There is a shared assumption that the coming decades will show huge technological progress in many areas relevant for climate policy. According to some, however, an emission reduction up to 80% by 2050 will be imaginable even without huge innovations. In their line of argument, it maybe concluded that major barriers relate to problems in government (political will, initiative, consistency etc.), especially at the level of the European Union. Other important barriers relate to private sector or consumers' inertia (especially because of lack of acceptance). This line of argument shows quite some similarity with the argument put forward in the IPCC Third Assessment Report: Significant greenhouse gas reductions are technologically feasible at acceptable costs, but social and institutional barriers are enormous.

Others however, question the social acceptability of measures that are necessary for realising –80% in the present technological context. Here becomes manifest the tension between on the one hand the criterion climate effectiveness and on the other the criteria sustainability and social support. Serious doubts and different viewpoints relate to options that are considered crucial for realising significant emission reductions.

Box 10 Criteria for long-term climate policy developed in de dialogue

- *Climate effectiveness:* agreement exists that climate effectiveness should be the most important criterion in the stimulation of options to reduce emissions. The other criteria that came out of the dialogue may on occasion restrict the criterion of climate effectiveness.
- *Sustainability* means social, ecological and economical sustainability (people, planet, profit). Not everybody considers the favourable options for emission reduction equally sustainable. This especially counts for CO_2 storage, biomass and hydrogen. At the same time, it is recognised that the impacts of climate change, even if a world wide reduction is realised in the order of 80% for the Netherlands is implemented, can be such that these controversial options cannot be neglected.
- Long term climate policy and *social support* have to reinforce each other. According to some, this assumes that the climate policy should follow the current developments in the sector (Agriculture) and that the consumer should be actively involved in this policy (Housing). A quite general impression is that important options, such as CO_2 storage, biomass and wind do not have a high score on the criterion of social support. In turn, the options, which seem to have high social support, have a low score on the criterion of cost effectiveness.
- *Cost effectiveness*: in a choice between options, the alternative that realises the highest reductions against the lowest costs will be preferred. It should be noticed that this criterion is mainly suitable for comparing options, which are already completely developed. Yet, the question is to what extent this can be assumed in the assessment of long-term developments, since the uncertainties on the developments of costs are huge.
- The social support for climate policy will be enhanced if options are offered which do justice to the co*nsumers' freedom of choice*. Assumed is that there is a general trend toward more consumer sovereignty that will continue over the next decades. This criterion can conflict with cost effectiveness. For, some options will only be cost effective if they are applied on a very large scale. A hydrogen infrastructure requires large infrastructure investments, but it restricts the consumers' freedom of choice.
- *Governmental / administrative fit* points to the preference for options which can be implemented with the current set of instruments in the Netherlands or fit in properly with European rules.
- The criterion *consistency of governmental policy* especially points to the tension between climate policy and liberalisation of the energy market, which has been spotted in different dialogue groups.
- *Technical reliability* refers to he robustness of options. Some link this criterion to a preference for simple, low tech options with a long life time and which are easy to repair in case something goes wrong. The dominant culture has a bias in favour of high tech, yet relatively vulnerable options.
- *Potential for innovation* means that options will be assessed in relation to their capability to generate further sustainable technological innovations. The assumption that underlies this criterion is that large-scale innovations will be needed, since the degree of sustainability of options as CO_2 storage and biomass is doubtful.

CO_2 removal and storage

There is concern that carbon, once stored underground, can leak out at a certain point in time with potentially serious consequences for local life. Another question relates to the possibilities for government and society to manage and monitor underground CO_2 for an infinite period of time. In addition to this resistance, there concerns have been raised that a choice for large-scale CO_2 removal and storage will lead to a neglect of sustainable options, especially the implementation and further development of solar and wind. In contrast with this line of argument, it has been put forward that climate change, even if drastic emission reductions will be realised by 2050, may have irreversible impacts on highly valued eco-systems. In this case, CO_2 removal and storage can probably not be avoided. After all, *if the sustainability criterion warrants objections against* CO_2 *under the ground, then this same criterion can certainly not lead to accept an ongoing increase of* CO_2 *in the atmosphere*. An additional advantage of this option is perhaps that, once it has proven to be cost-effective, The Netherlands are not so much dependant on other countries and Europe in making the transition toward a CO_2 neutral energy system.

It can be concluded from the dialogue that, under stringent conditions, future CO_2 removal and storage may meet with sufficient social support. However, the first of conditions to be fulfilled will be the strong support and encouragement of those options that are, on the long term, expected to make CO_2 storage unnecessary.

Biomass

Biomass, too, is not generally considered a sustainable option. There is scepticism with respect the availability of biomass, given the amount and diversity of claims in various sectors. Concerns have been raised that once more, the industrialised countries, which show a rapid growth of energy use and transport, will solve their problems at the expense of less well-to-do regions such as South-America, Africa and Eastern Europe. Will food security in these regions not be endangered by a shift to large-scale biomass production? What negative social impacts can be expected from this? Yet, it is largely recognised that, at least theoretically, sufficient land is available for biomass. Starting biomass production on these (degraded) lands, will bring considerable benefits to the exporting countries. Therefore, the problems faced because of a future large-scale biomass production and use will not necessarily lead to a rejection of this option. However, the concern related to its social and ecological impacts renders a plea for sustainable production and use (chain optimisation) of biomass. One of the barriers identified in this respect is the global climate regime itself, as it provides incentives for dumping biomass from the forest right into the oven.

Renewables

As on the one hand, the dialogue anticipates a variety of problems related to the sustainability of clean fossil and biomass, on the other it observes that The Netherlands, given the current state of technology, face limitations with respect to the potential of renewables (especially solar and wind). These limitations are partly physical in nature (too little space for wind turbines and solar panels), partly because of the costs of back-up systems that are expected to be huge. Nevertheless, there are no limits in an absolute sense – there is always the possibility of import and, as systems become better linked in the future, the necessity of back-ups is likely to decrease. In order to better understand the divergent views on the potential for sustainable options, one must distinguish the positions of the various sectors. For the sector Housing, renewables can already make a difference now. For this sector, the limits to renewables have not been reached yet. Major breakthroughs seem not required in order to realise –80%. It is also expected that these options will meet with a positive attitude among consumers. For these sectors that are most responsible for current Dutch greenhouse gas emissions, Transport and Industry, solar and wind do not constitute a serious alternative for now or the decades to come, though. Moreover, the public acceptance of renewables may be questioned, too. It is not unlikely that a hypothetical offshore windmill park with a 20.000 Mwe potential along the cost line of Northern Holland (from Den Helder to Zandvoort) will meet with public resistance. Is it sustainable to externalise problems from land to the sea?

Energy efficiency

Demand side management is for all sectors a crucial option to bring down emissions. As regards the possibilities for further efficiency improvement, opinions diverge. Some are worried that the tempo of efficiency improvement (since the seventies about 1 - 2% per annum) cannot be maintained. Existing processes get very close to the thermodynamic minimum. Hence, a plea is made for the strong encouragement of process innovations through broad cooperation between companies.

Breakthroughs in sustainable and demand side management are also considered necessary as to avoid (too large) claims on CO_2 removal and storage and biomass in the future. Next to and articulated with the issue of technological feasibility of –80% in a socially acceptable way, a variety of views have been articulated with respect to the role of government in future climate policy. Are market instruments and institutions, especially an emissions trading regime, adequate, given the necessity of major technological breaktroughs and the implications of many options for infrastructure? Can Dutch government and European government make a difference in an era of liberalising energy markets? The dialogue observes government as well as big companies take less interest in (fundamental) research as an impact of liberalization. Some however expect that the shift from regulatory toward market instruments, especially the introduction of a system of tradable emission permits, will after some time generate the technological innovations needed. If such a system includes a cap, which is regularly revised in a downward direction, options that are initially too expensive will become cost-effective. Others raise doubts here. They put forward that government and not the market is the institution capable to safeguard long-term perspectives.

Box 11 Conflicting views on the transition toward an -80% energy system

Emission trading regime / other market related instruments? Technology available?	On the mid/long term,	As soon as possible
Not yet	R&D through non-competitive, cross-sectoral cooperation. Major role of government in financing and R&D infrastructure. D	Long-term standard setting for specific sectors or technologies / combine with ecotax to avoid externalities B
Yes	C To mobilize support for the adoption of innovations by non-market instruments (create lead customers).	A Acceptance and implementation of options by companies and consumers.

Based on Matthijs Hisschemöller, Magnus Andersson, Marleen van de Kerkhof and Willemijn Tuinstra: 'What we do not know yet about the institutions needed for the transition toward a decarbonised economy; A report from the COOL dialogue.' *Paper presented at the METRO Conference on Institutions and Instruments to Control Global Environmental Change*, 21-22 June 2001, Maastricht, The Netherlands: page 16.

Government is especially needed to stimulate and support research & development of a (limited) number of technologies and to perform as 'lead customer'. Moreover, government has also a traditional role to play in realising major infrastructure projects.

Box 11 summarises different views from the dialogue which link insights and perceptions as regards the available knowledge and technologies with opinions on the speed needed to implement market instruments and institutions. As an ideal-typical representation, Box 11 does injustice to the dialogue, because many issues, opinions and nuances are left unaddressed. What should be especially mentioned here is the observation from various dialogue groups that climate policies may benefit from a more active involvement of consumers who are willing to make a contribution.

In fact Box 11 distinguishes and solves four problems. In cell A an innovation is available at reasonable costs. Yet, the problem is how to promote its adoption through the market. The solution is found in giving CO_2 a price. There are a great number of options that this problem frame can be applied to. One of these may be CO_2 removal and storage, provided that safety is not an issue (any more). In cell B, no product is available yet, but it is reasonably expected to become available after some period of time. It is also clear who (which specific companies) will have to take care of this. Long term standard setting, as proposed for the development and implementation of CO_2 neutral transport fuels, is considered a market conform instrument that can easily evolve into a system of tradable permits. The problems identified in the right column of the table can both very well be addressed with market instruments. This is different for the left column of the table.

The main difference is that, instead of competition provoked by market (like) instruments, cooperation between parties is considered pivotal for solving their problems. In cell C, a product is available but for some reason (there maybe a variety of reasons here, including the costs of the product or the absence of a market) it cannot be made available through market competition. In order to stimulate its adoption government must use non-market instruments. The plea for a fixed share of renewables in the energy supply is an illustration of this kind of solution strategy. In cell D, the theoretical knowledge is available but a lot of R&D seems needed in order to put a product in the market. In this case – and different from the starting position in cell B- there may even not be a clear idea about the kind of product to be developed, the actors to get involved or the knowledge needed for realizing a break-through. Options that may fit in with this problem frame are breakthroughs in industrial process efficiency, or, for the long term, solar.

So far, the problems and accompanying solution trajectories have been presented as distinct and complementary. Together, they could be considered to sketch a trajectory for transition in time, starting with R&D and ending with measures to endorse fair market competition. In every day practice, however, the distinction between these kinds of problems may be far from obvious. It already turned out that the question as to whether state of the art technology may help in realising major reductions is answered differently by the sectors Housing and Industry. To explore the meaning of this point in more detail, efficiency is taken as an example.

In the dialogue, divergent views on efficiency improvement were articulated. On the one hand, this can be explained by the fact that efficiency is a package including a diversity of options. Some are already available and can be implemented soon. Others still require fundamental research and technology development. From this observation it might be concluded that, hence, the policy instrumentation needed for realisation should also be very diverse. However, other participants in the dialogue have put forward opposing views, which may justify the inference that the dialogue has articulated *conflicting* views on one and the same issue. The view that technological barriers constitute the main obstacle at this moment can be addressed by a strategy as proposed in cell D, non-competitive cooperation and strong government support for R&D. In contrast, there is the observation that, in the past, efficiency has shown a rapid take-off in response to external pressures (energy crisis, price increase). From this, one may conclude that incentives for further improvement of efficiency will be provided by a regime of tradable emission rights (cell A in Box 11).

This example raises several important questions: Who decides in the decades to come what kind of problem is at stake and which solution strategy fits best? Then, when it turns out that one does not face one single problem but different ones (in which case the views put forward are not really *conflicting*): How ‘tailor-made’ must a policy be in order to implement the best technology? How ‘tailor-made’ can a policy possibly be in order not to be caught in detail? When get policy instruments in conflict with each other and looses policy its transparency and consistency? Up to what level does liberalisation allow for far-reaching government support, if this could be lead to the promotion of certain technological developments at the expense of others? The major challenge in the development of long-term climate policy probably lies in addressing this type of questions at the crossroads of technology, economy and governance.

It is mainstream to assert that an environmental policy must always use a mix of policy instruments. As to whether this is always possible or that choices have to be made is a somewhat neglected issue. A close examination of National Dialogue unfolds the lesson that it is very important indeed to explore and investigate when and how different policy instruments may get into conflict.

Box 12 Some process lessons from the National Dialogue

- A dialogue group with stakeholders from different expert fields, with different opinions and views, will increase the possibility to generate new insights for policy.
- The success of the group depends heavily on the quality of process support. It is critical that the different steps in the process are transparent to the participants.
- In a demand driven dialogue, it is crucial to choose as a starting point for the discussion the wishes, concerns and expectations of all participants.
- A certain degree of autonomy of the dialogue groups will increase the participants' involvement in the work of the group and in the end product.
- The role of scientific support in a dialogue deserves special attention. The information that is offered should be accessible, compact and tailor made. Furthermore, a proper communication of information is of vital importance.
- The backcasting methodology results in insights related to chances and obstacles in the implementation of options for climate policy. However, it does not by itself provoke the participants to articulate and discuss conflicting views.
- Using future images and backcasting stimulates a long term scope in the dialogue. These methods do not cut-off the participants from their own experiences, opinions and interests. This should not be the project's intention.
- An extended preparation phase and a good budget are crucial for a proper course of the dialogue.
- To work in an interdisciplinary team requires careful communication and a good working plan. This takes time.

5. Preparing for the long term: recommendations

This section presents recommendations on how to get prepared for the long term. These recommendations relate to actions taken in the period between now and 2012. They are directed to government, business and the environmental and consumers movements. Point of departure is the general picture that comes from the dialogue:

> *From the National Dialogue it is concluded that emission reductions up to –80% by 2050 are imaginable. Not all dialogue participants are (equally) optimistic on the feasibility of such reductions, though. More in particular, there is considerable doubt as to whether these reductions will be possible without causing or aggravating other problems than climate change here or elsewhere. This leads to the conclusion that –80% may come in reach for The Netherlands in a socially acceptable manner if, next to overcoming many social, institutional and psychological barriers, in specific areas major technological breakthroughs will be realized. European and Dutch governments are supposed to take a leading roll in this respect, but it is doubted if they can do this.*

This conclusion indicates on the one hand to a mild optimism, on the other hand to persistent doubts and concerns related to the desirability of certain options and the capabilities of government. An effective long-term government strategy must find a way to deal with these contradictory impressions, with the observed doubts and divergent opinions. After all, they all point to real issues that must be coherently addressed. The recommendations 4 – 10 below deal with these issues. The dialogue has also generated some shared views as regards general factors that will make a long-term climate policy successful. These are dealt with in the recommendations 1 - 3. Box 13 provides in addition information on specific recommendations for the sectors, developed by the dialogue groups.

General

1. *Use the coming 10 years well!* It is already possible to start implementing various options for the four sectors. But, although the climate problem is urgent and its urgency is likely to increase the coming period, it is especially important to take due time to work out a coherent long-term strategy and take actions accordingly. In this respect it is critical to fine tune substance and process, and to coordinate actions at the global, European and national level. Also the timing of decisions (not too late, but not too fast either) is of critical importance.
2. *Enhance a sustained involvement with the issue!* It is essential to create the conditions necessary to enable the transition toward a CO_2 neutral energy system. To these conditions belong:
   - a sense of urgency among stakeholders and the public at large over a long period of time, in order to tame this issue,

Box 13 A selection of specific recommendations for the four sectors

Housing

- Integrated design, include the use of passive solar energy in building codes;
- Support solar PV by stimulating agreements between solar PV producers and energy suppliers about liability and incentives (government);
- Stimulate the use of wood in house building;
- Address the issue of groundwater contamination by antifreeze in heat pumps, generic subsidies (government).

Industry and Energy

- Measures to stimulate heat power generators in industry, trajectory for linking heat power generators with clean fossil options (government, companies);
- Develop plans to implement a hydrogen infrastructure (step by step introduction or radical change), (all parties involved);
- Develop industrial parks in accordance with ecological principles and create agreements between companies to coordinate the demand and supply of heating and cooling (sector).

Agriculture

- Gradually diminish production and use of artificial fertilizer (Netherlands, sector, EU);
- Coordinate policies regarding nature and landscape with those regarding the climate issue (sinks) (Netherlands, managers of nature reserves);
- Create good house keeping on the farm (sector);
- Make an inventory of sustainable food options (all parties involved).

Transport

- Develop long-term standard setting for the transition to a CO_2 neutral fuel market (at an European level);
- Internalize the costs of CO_2 into the fuel prize (at an European level);
- Introduce a test for the climate impacts of new infrastructure (Netherlands);
- Include transport as a part of environmental management systems and certification schemes (sector).

- A sustained political will to make sincere efforts (for decades high on the political agenda),
- Consistency of government policy provides private parties with the encouragement to make their contribution.

Long-term policy must next to (but not in isolation from) existing short-term policy allow for critical evaluation. The approach taken in the COOL project, a dialogue between science and stakeholders from society, may serve quite well to elaborate long-term strategies. Therefore, it is important to use the process lessons from COOL (Box 12 highlights some salient lessons from the COOL process).

3. *Social support for –80% as a long-term target?* The National Dialogue has addressed the feasibility of emission reductions up to 80% and not its desirability. The outcomes from the dialogue and the involvement of its participants justify raising the question of establishing a long-term reduction target in the order of –80% in a national as well as a European context. In order to fully explore the implications and impacts of such a decision, sufficient time is needed. Answering such a question supposes that the specific themes below are coherently addressed.

Themes for long term climate policy

4. *Make an integrated assessment of the effectiveness of instruments and institution over time!* The COOL dialogue signals a relation between the technological, economic and political / institutional aspects of long-term climate policy. It is critical to get informed on the effectiveness of instruments and institutions needed to realise reductions in the various sectors. At this moment, an integrated approach to this issue, which involves different disciplines, is lacking. Such an approach at the crossroads of technology, economics and governance, must shed a new light on the interactions between choice of instruments and (unwanted) policy effects over time.
5. *Knowledge, knowledge infrastructure*: The dialogue suggests that it is critical to heavily invest in fundamental and applied research to force major breakthroughs in a European context. It is proposed to establish an international Institute of Excellence in cooperation between governments, business and science, which will work on optimising solar PV. In a similar vein, initiatives may be taken with respect to hydrogen and biomass. These proposals from the dialogue are in contrast with the movements of retreat from Dutch government and business with respect to research at this moment. To stimulate R&D must be accompanied with a critical reflection on current knowledge infrastructure, especially on its transparency and its accessibility for demanding parties.

Box 14 Publications in the context of the National Dialogue

Arentsen, M. and E. Luiten (2001). Shaping future technology. Position paper for the COOL-dialogue on climate change options. CTSM, Twente en U&U, Utrecht.

Bennett, G. (2001). Long-term institutional change and climate control measures in Europe. Syzygy, Nijmegen.

de Boer, J. (2001). Consumptiecultuur en Klimaatverandering. Essay opgesteld in het kader van de COOL-dialoog. IVM, Amsterdam.

Faaij, A., S. Bos, J. Spakman, D.J. Treffers, C. Battjes, R. Folkert, E. Drissen, C. Hendriks and J. Oude Lohuis (1999). Beelden van de toekomst. Twee visies op de Nederlandse energievoorziening ten behoeve van de Nationale Dialoog.

Faaij, A., M. van de Kerkhof, M. Hisschemöller, R. Folkert, H. Jeeninga, M. Kok, O.J. Kuik, P. Kroon, A. Seebregts, J. Spakman, D.J. treffers and D. de Jager (2001). Kernthema's van de strategische visie voor het lange termijn klimaatbeleid in Nederland. Hoofdpunten uit de strategische visie van de groepen Gebouwde Omgeving, Industrie, Landbouw & Voeding, Verkeer & Vervoer van de Nationale Dialoog van het COOL project.

Folkert, R.J.M. (2001). CO_2-opslag: potentieel en milieu/veiligheidsaspecten. Notitie ten behoeve van de Integratie Workshop COOL. RIVM, Bilthoven.

Hisschemöller, M., M. van de Kerkhof and O.J. Kuik (2000). Climate OptiOns for the Long term. De Nationale Dialoog – Tussenrapport. W-00/02 IVM, Amsterdam.

Hisschemöller, M. , M. van de Kerkhof, O.J. Kuik, M.T.J. Kok, J. Spakman, D.J. Treffers, M. Spanjersberg, A. Faaij, J. Oude Lohuis, A. Seebregts, P. Kroon, J.A. Annema, H. Jeeninga and W. Tuinstra (2001). Backcasting exercities in COOL – De Nationale Dialoog. W-01/03. IVM, Amsterdam.

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Spakman, J., R. Folkert and G.J. van den Born (2001). Biomassa: potentieel en implicaties.

Spakman, J., G.J.v.d.Born, G.J.Elzenga, K.W.van der Hoek and R.J.M. Folkert (2001). Relaties tussen Landbouw, Klimaat en Beleid.

Thema III Assessment Team (1999). Informatiepakket fact sheets ten behoeve van de Nationale Dialoog.

Treffers, D.J. (2000). Energiebesparing in de Industrie. Paper voor de Nationale Dialoog van het COOL project. NW&S, Utrecht.

Van Lieshout, M. and A.F.L. Slob (2001). ICT en klimaatverandering. Essay opgesteld in het kader van de COOL-dialoog. TNO, Delft.

Van Luttervelt, P. (2001). De kracht en invloed van de consument. Een ondergewaardeerde factor. Den Haag.

Van Soest, J.P. (2000). Klimaatbeleid voor de Industrie. Essay in het kader van de COOL-dialoog. LE, Delft.

Van Zeijts, H., W.J. van der Weijden, and M.C. Hanegraaf. Landbouw en broeikaseffect: systeemgrenzen, toekomstbeelden en mogelijke maatregelen. Utrecht, Centrum voor Landbouw en Milieu.

6. *Market development and the adoption of innovations:* In addition to proposals for a strong impetus for R&D, the dialogue has pointed to barriers for innovations to penetrate the market. Traditionally, government takes on the role of lead customer, that is

it takes the risks linked to novel products. Next to government, also environmental and consumer NGOs may be of significance here, e.g. by mobilizing lead customers who then may become shareholder in the new product.

7. *Implications for space and infrastructure*: In close relation to the recommendations under 4 and 5, it is critical to get a clear picture of the implications from climate options for the use of scarce space and infrastructure. Such an assessment would have to focus on a variety of issues, such as expansion of the grid, underground or surface grid and pipelines, requirements to gas stations, and all kinds of other implications with respect to water ways, bridges, landscape architecture, design and management of industrial areas, opportunities for (re)locating businesses and the like. As yet, there is much to learn about costs, sustainability, as well as the division of labor between government and private parties in adjusting infrastructure to climate policies.
8. *Empowering consumers*: The potential of consumers as actors in the climate issue has so far been underestimated in Dutch climate policy. Attention for consumers largely focuses on providing incentives for behavior change at the level of the individual. Still, an (organized) intervention by consumers may constitute a stimulus to accelerate changes at the supply side. It should be explored what opportunities exist to increase consumers' involvement. A strengthening of the individual responsibility and consumer sovereignty must be pivotal objectives in such an assessment. One instrument to be further investigated is to provide individual consumers with emission rights.
9. *Trajectory Biomass.* In this trajectory, all barriers for a large-scale adoption of biomass are looked at in an integrated way. At the international level, initiatives are needed to develop a system for certifying sustainably produced biomass. One of the major topics should further be as to whether chain optimization is a workable national and international objective (at this stage the climate regime provides incentives for burning biomass). This question also implies the opportunities for developing an international monitoring system. Nationally and at the European level, barriers for biofuels, (such as fees for alcohol), must be inventoried and addressed. Research into various biomass potentials must be intensified.
10. *Trajectory CO_2 removal and storage*. This trajectory delivers all relevant information to enable political decision on CO_2 removal and storage. Special attention must be given to safety issues related to transport and underground storage, as well as to possible reactions underground. Demonstration projects may be started. The assessment and the decision making should specify under what strict conditions (e.g. safety, continuation in investments in renewables), when and at what kinds of locations CO_2 storage will be permitted. Given the nature of the resistance against this option and at the same time the opportunities this option may provide to bring down emissions significantly and at reasonable costs, it is for this trajectory even more so recommendable to have an open dialogue that is able to define alternatives for decision.

Box 15 Dialogue participants (part 1)

Group Housing

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J. van der Sar	Kerk en Wereld
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Box 15 Dialogue participants (part 2).

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Group Transport

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H. van Manen	van Gend en Loos
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A.B.M. van der Plas	Nederland Distributieland
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